

**Source Test Report for
2022 Initial Certification CEMS RATA Testing
Boiler No. 11 (EUBOILER#11)
Graphic Packaging International, LLC
Kalamazoo, Michigan**

Prepared For:

**Graphic Packaging International, LLC
1500 North Pitcher Street
Kalamazoo, MI 49007**

Prepared By:

**Montrose Air Quality Services, LLC
10060 Brecksville Road
Brecksville, OH 44141**

For Submission To:

**Michigan Department of Environment, Great Lakes, and Energy
525 West Allegan
Lansing, MI 48909**

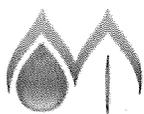
**Michigan Department of Environment, Great Lakes, and Energy
7953 Adobe Road
Kalamazoo, MI 49009-5026**

Document Number: MW011AS-015953-RT-1045

Test Date: June 9, 2022

Submittal Date: August 3, 2022

B1678-test 20220609



MONTROSE
AIR QUALITY SERVICES



Review and Certification

All work, calculations, and other activities and tasks performed and presented in this document were carried out by me or under my direction and supervision. I hereby certify that, to the best of my knowledge, Montrose operated in conformance with the requirements of the Montrose Quality Management System and ASTM D7036-04 during this test project.

Signature: John Nestor **Date:** 08 / 02 / 2022

Name: John Nestor **Title:** District Manager

I have reviewed, technically and editorially, details, calculations, results, conclusions, and other appropriate written materials contained herein. I hereby certify that, to the best of my knowledge, the presented material is authentic, accurate, and conforms to the requirements of the Montrose Quality Management System and ASTM D7036-04.

Signature: robert j lisy jr **Date:** 08 / 03 / 2022

Name: Robert J. Lisy, Jr. **Title:** Reporting Hub Manager

Table of Contents

<u>Section</u>	<u>Page</u>
1.0 Introduction	5
1.1 Summary of Test Program	5
1.2 Key Personnel	6
2.0 Plant and Sampling Location Descriptions.....	8
2.1 Process Description, Operation, and Control Equipment.....	8
2.2 Facility and Reference Method (RM) CEMS Descriptions	8
2.3 Flue Gas Sampling Location	8
2.4 Operating Conditions and Process Data	9
3.0 Sampling and Analytical Procedures	10
3.1 Test Methods	10
3.1.1 EPA Method 1.....	10
3.1.2 EPA Method 3A.....	10
3.1.3 EPA Method 4.....	10
3.1.4 EPA Method 7E.....	11
3.1.5 EPA Method 19.....	12
3.1.6 EPA Performance Specification 2.....	13
3.1.7 EPA Performance Specification 3.....	13
3.2 Process Test Methods.....	13
4.0 Test Discussion and Results.....	14
4.1 Field Test Deviations and Exceptions.....	14
4.2 Presentation of Results.....	14
5.0 Internal QA/QC Activities	18
5.1 QA/QC Audits.....	18
5.2 QA/QC Discussion.....	18
5.3 Quality Statement	18

List of Appendices

A Field Data and Calculations	19
-------------------------------------	----

- A.1 Sampling Locations..... 20
- A.2 EUBOILER#11 Data Sheets..... 25
- A.3 Instrumental RM CEMS Test Data 46
- A.4 Example Calculations 57
- B Facility CEMS and Process Data 60
- C Quality Assurance/Quality Control 71
 - C.1 Units and Abbreviations..... 72
 - C.2 Manual Test Method QA/QC Data..... 81
 - C.3 Instrumental Test Method QA/QC Data..... 96
 - C.4 Accreditation Information/Certifications..... 109
- D Regulatory Information 116
 - D.1 Regulatory Correspondence 117
 - D.2 Test Plan 120

List of Tables

- 1-1 Summary of Test Program 5
- 1-2 Summary of Part 60 RATA Results – EUBOILER#11 CEMS..... 6
- 1-3 Test Personnel and Observers..... 7
- 2-1 Facility CEMS Information 8
- 2-2 RM CEMS Information..... 8
- 2-3 Sampling Location..... 8
- 4-1 NO_x (lb/MMBtu) RATA Results - EUBOILER#11 CEMS..... 15
- 4-2 NO_x (ppmvw) RATA Results - EUBOILER#11 CEMS..... 16
- 4-3 CO₂ (%-Wet) RATA Results - EUBOILER#11 CEMS 17
- 5-1 Part 60 Gas Cylinder Information 18

List of Figures

- 3-1 EPA Method 4 Sampling Train 11
- 3-2 EPA Method 3A and 7E Sampling Train 12

1.0 Introduction

1.1 Summary of Test Program

Graphic Packaging International, LLC (Graphic Packaging) (State Registration No.: B1678) contracted Montrose Air Quality Services, LLC (Montrose) to perform the Annual Quality Assurance (QA) Relative Accuracy Test Audit (RATA) for the Continuous Emission Monitoring Systems (CEMS) associated with Boiler No. 11 (EUBOILER#11) at the Graphic Packaging facility located in Kalamazoo, Michigan. Testing was performed on June 9, 2022, for the purpose of satisfying the emission testing requirements pursuant to Michigan Department of Environment, Great Lakes, and Energy (EGLE) Permit-to-Install (PTI) No. 133-19A by evaluating the quality of the emissions data produced by Graphic Packaging's CEMS in accordance with 40 CFR Part 60, Appendices B and F.

The specific objectives were to:

- Verify the relative accuracy (RA) of the EUBOILER#11 CEMS for nitrogen oxides (NO_x) emissions (lb/MMBtu) (as NO₂), NO_x concentration (ppmvw), and carbon dioxide (CO₂) concentration (%-Wet) in accordance with Performance Specifications 2 (PS-2) and 3 (PS-3)
- Conduct the test program with a focus on safety

Montrose performed the tests to measure the emission parameters listed in Table 1-1.

Table 1-1
Summary of Test Program

Test Date(s)	Unit ID/ Source Name	Activity/Parameters	Test Methods	No. of Runs	Duration (Minutes)
6/9/2022	EUBOILER#11	CO ₂	EPA 3A	10	21
6/9/2022	EUBOILER#11	Moisture	EPA 4	4	75, 30
6/9/2022	EUBOILER#11	NO _x	EPA 7E	10	21

For the Part 60 RATA, of the ten (10) RATA runs performed, nine were used to determine the RA of the EUBOILER#11 CEMS.

To simplify this report, a list of Units and Abbreviations is included in Appendix C.1. Throughout this report, chemical nomenclature, acronyms, and reporting units are not defined. Please refer to the list for specific details.

This report presents the test results and supporting data, descriptions of the testing procedures, descriptions of the facility and sampling locations, and a summary of the quality assurance procedures used by Montrose. The RA test results are summarized and compared to their respective regulatory requirements in Table 1-2. Detailed results for individual test runs can be found in Section 4.0. All supporting data can be found in the appendices.

The testing was conducted by the Montrose personnel listed in Table 1-3. The tests were conducted according to the test plan dated April 4, 2022, and revised April 11, 2022, that was submitted to EGLE.

Table 1-2
Summary of Part 60 RATA Results – EUBOILER#11 CEMS
June 9, 2022

Parameter/Units	Regulatory Reference	RA	Allowable
Part 60			
Carbon Dioxide (CO₂)			
% volume wet	PS-2, PS-3	0.20	≤ 1.0% CO ₂
Nitrogen Oxides (NO_x)			
ppmvw	PS-2	5.42	≤ 20.0% of RM
lb/MMBtu (as NO ₂)	PS-2	8.03	≤ 20.0% of RM

1.2 Key Personnel

A list of project participants is included below:

Facility Information

Source Location: Graphic Packaging International, LLC
 1500 North Pitcher Street
 Kalamazoo, MI 49007

Project Contact: Steven Smock
 Role: Environmental Manager
 Company: Graphic Packaging
 Telephone: 269-383-5453
 Email: steven.smock@graphicpkg.com

Agency Information

Regulatory Agency: EGLE
 Agency Contact: Lindsey Wells
 Telephone: 517-282-2345
 Email: Wellsl8@michigan.gov

Testing Company Information

Testing Firm: Montrose Air Quality Services, LLC	
Contact: Robert J. Lisy, Jr.	John Nestor
Title: Reporting Hub Manager	District Manager
Telephone: 440-262-3760	248-548-8070
Email: rlisy@montrose-env.com	jonestor@montrose-env.com

Test personnel and observers are summarized in Table 1-3.

Table 1-3
Test Personnel and Observers

Name	Affiliation	Role/Responsibility
John Nestor	Montrose	District Manager, QI
Shawn Jaworski	Montrose	Field Project Manager, QI
Scott Dater	Montrose	Field Technician, QI
Steven Smock	Graphic Packaging	Observer/Client Liaison/Test Coordinator
Lindsey Wells	EGLE	Observer

2.0 Plant and Sampling Location Descriptions

2.1 Process Description, Operation, and Control Equipment

Graphic Packaging International operates two natural gas-fired boilers (EUBOILER#10 and EUBOILER#11) to generate steam for use in facility operations. EUBOILER#11 is equipped with low NO_x burners and flue gas recirculation. It has a maximum heat input rate of 311 MMBtu/hr and was in operation for this test event.

2.2 Facility and Reference Method (RM) CEMS Descriptions

The Facility CEMS analyzer information is presented in Table 2-1, and the RM CEMS analyzer information is presented in Table 2-2.

**Table 2-1
Facility CEMS Information**

Analyzer Type	Manufacturer	Model No.	Serial No.	Range
CO ₂	Thermo Scientific	iQ Series 410	1202759351	0-25%
NO _x	Thermo Scientific	iQ Series 42	1202759349	0-100 ppm

**Table 2-2
RM CEMS Information**

Analyzer Type	Manufacturer	Model No.	Serial No.	Range
CO ₂	Teledyne	T802	197	0-20.59%
NO _x	Teledyne	T200H	84	0-90.83 ppm

2.3 Flue Gas Sampling Location

Information regarding the sampling location is presented in Table 2-3.

**Table 2-3
Sampling Location**

Sampling Location	Stack Inside Diameter (in.)	Distance from Nearest Disturbance		Number of Traverse Points
		Downstream EPA "B" (in./dia.)	Upstream EPA "A" (in./dia.)	
EUBOILER#11 Exhaust Stack (SVBLR11)	62.3	140.0 / 2.2	310.0 / 5.0	Flow: 12 (6/port) Gaseous: 3

The sampling location was verified in the field to conform to EPA Method 1. Acceptable cyclonic flow conditions were confirmed prior to testing using EPA Method 1, Section 11.4. See Appendix A.1 for more information.

2.4 Operating Conditions and Process Data

The CEMS RATA was performed while EUBOILER#11 was operating at greater than 50% of permitted capacity conditions.

Plant personnel were responsible for establishing the test conditions and collecting all applicable unit-operating data. The Facility CEMS and process data that was provided is presented in Appendix B. Data collected includes the following parameters:

- Facility CEMS data for each 21-minute RATA run
- Steam flow rate, lb/hr
- Gas flow rate, kscfh
- Heat input rate, MMBtu/hr

3.0 Sampling and Analytical Procedures

3.1 Test Methods

The test methods for this test program have been presented in Table 1-1. Additional information regarding specific applications or modifications to standard procedures is presented below.

3.1.1 EPA Method 1, Sample and Velocity Traverses for Stationary Sources

EPA Method 1 is used to assure that representative measurements of volumetric flow rate are obtained by dividing the cross-section of the stack or duct into equal areas, and then locating a traverse point within each of the equal areas. Acceptable sample locations must be located at least two stack or duct equivalent diameters downstream from a flow disturbance and one-half equivalent diameter upstream from a flow disturbance.

The sample port and traverse point locations are detailed in Appendix A.

3.1.2 EPA Method 3A, Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)

EPA Method 3A is an instrumental test method used to measure the concentration of O₂ and CO₂ in stack gas. The effluent gas is continuously or intermittently sampled and conveyed to analyzers that measure the concentration of O₂ and CO₂. The performance requirements of the method must be met to validate data.

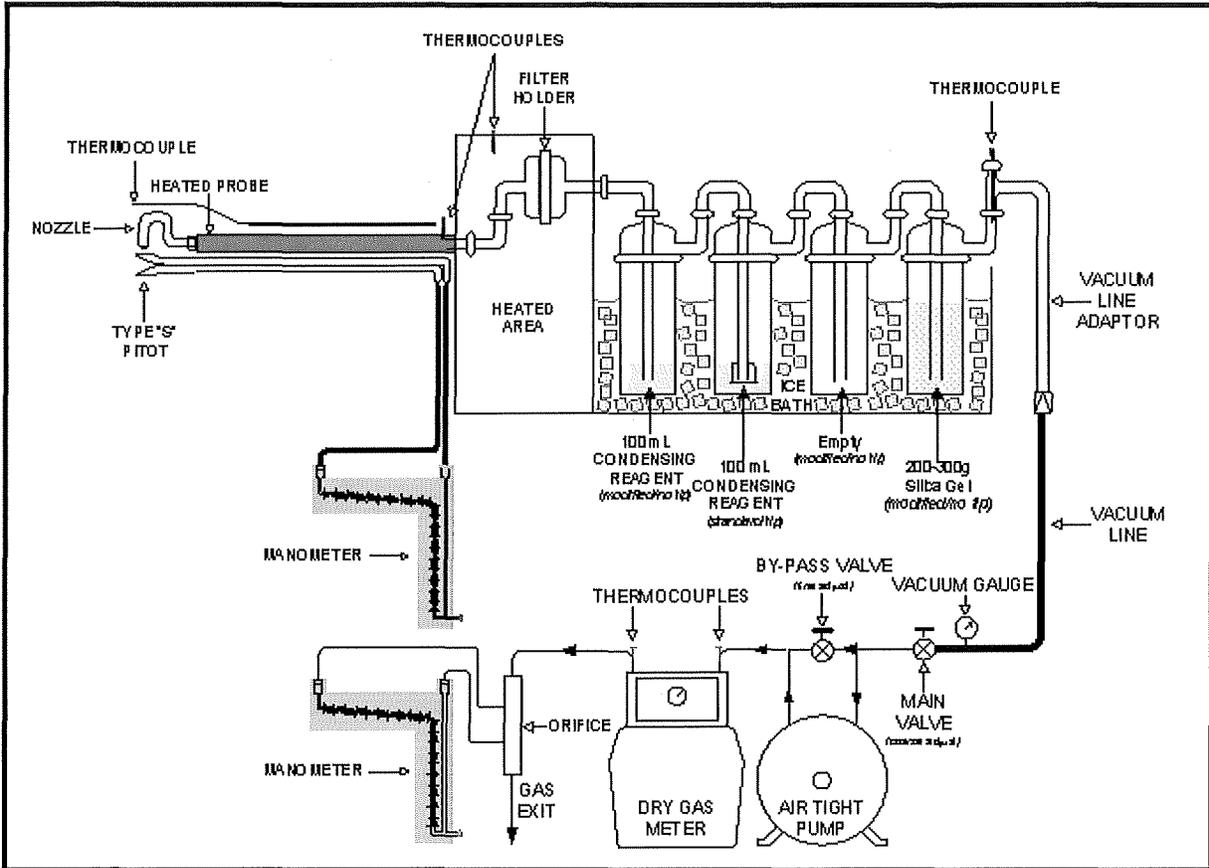
The typical sampling system is detailed in Figure 3-2.

3.1.3 EPA Method 4, Determination of Moisture Content in Stack Gas

EPA Method 4 is a manual, non-isokinetic method used to measure the moisture content of gas streams. Gas is sampled at a constant sampling rate through a probe and impinger train. Moisture is removed using a series of pre-weighed impingers containing methodology-specific liquids and silica gel immersed in an ice water bath. The impingers are weighed after each run to determine the percent moisture.

The typical sampling system is detailed in Figure 3-1.

Figure 3-1
EPA Method 4 Sampling Train

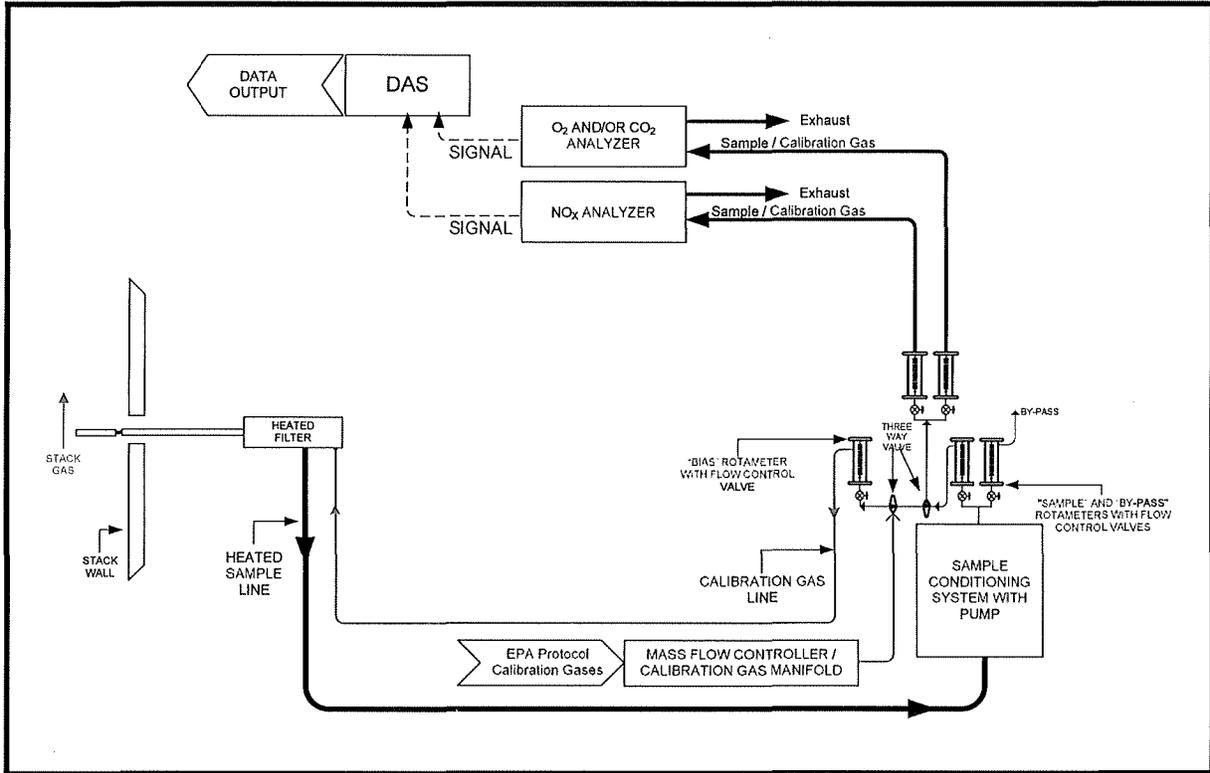


3.1.4 EPA Method 7E, Determination of Nitrogen Oxides Emissions from Stationary Source (Instrumental Analyzer Procedure)

EPA Method 7E is an instrumental test method used to continuously measure emissions of NO_x as NO_2 . Conditioned gas is sent to an analyzer to measure the concentration of NO_x . NO and NO_2 can be measured separately or simultaneously together but, for the purposes of this method, NO_x is the sum of NO and NO_2 . The performance requirements of the method must be met to validate the data.

The typical sampling system is detailed in Figure 3-2.

Figure 3-2
EPA Method 3A and 7E Sampling Train



3.1.5 EPA Method 19, Determination of Sulfur Dioxide Removal Efficiency and Particulate Matter, Sulfur Dioxide, and Nitrogen Oxide Emission Rates

EPA Method 19 is used to calculate mass emission rates in units of lb/MMBtu. EPA Method 19, Table 19-2 contains a list of assigned fuel factors for different types of fuels, which can be used for these calculations.

3.1.6 EPA Performance Specification 2, Specifications and Test Procedures for SO₂ and NO_x for Continuous Emission Monitoring Systems in Stationary Sources

EPA Performance Specification 2 is a specification used to evaluate the acceptability of SO₂ and NO_x CEMS. The evaluation is conducted at the time of installation or soon after, and whenever specified in the regulations. The CEMS may include, for certain stationary sources, a diluent (O₂ or CO₂) monitor. The RA and CD tests are conducted to determine conformance of the CEMS to the specification.

3.1.7 EPA Performance Specification 3, Specifications and Test Procedures for O₂ and CO₂ Continuous Monitoring Systems in Stationary Sources

EPA Performance Specification 3 is a specification used to evaluate the acceptability of O₂ and CO₂ CEMS. The evaluation is conducted at the time of installation or soon after, and whenever specified in the regulations. This specification applies to O₂ or CO₂ monitors that are not included under PS-2. The RA and CD tests are conducted to determine conformance of the CEMS to the specification.

3.2 Process Test Methods

The test plan did not require that process samples be collected during this test program; therefore, no process sample data are presented in this test report.



4.0 Test Discussion and Results

4.1 Field Test Deviations and Exceptions

The test plan submitted to EGLE was based on the Facility CEMS recording O₂ (%-Dry) and NO_x (ppmvd). However, once on-site, it was determined that the Facility CEMS recorded CO₂ (%-Wet) and NO_x (ppmvw). EPA Method 4 was added to the project to convert the measured RM concentrations to a wet-basis.

4.2 Presentation of Results

The RA results are compared to the regulatory requirements in Table 1-2. The results of individual test runs performed are presented in Tables 4-1 through 4-3. Emissions are reported in units consistent with those in the applicable regulations or requirements. Additional information is included in the appendices as presented in the Table of Contents.

**Table 4-1
NO_x (lb/MMBtu) RATA Results -
EUBOILER#11 CEMS**

Run #	Date	Time	RM	CEMS	Difference	Run Used (Y/N)	Heat Input (MMBtu/hr)
1	6/9/2022	7:30-7:51	0.028	0.030	-0.002	Y	202.4
2	6/9/2022	8:05-8:26	0.028	0.030	-0.002	Y	200.7
3	6/9/2022	8:37-8:58	0.028	0.030	-0.002	Y	207.6
4	6/9/2022	9:10-9:31	0.028	0.030	-0.002	Y	207.5
5	6/9/2022	9:42-10:03	0.028	0.030	-0.002	Y	210.0
6	6/9/2022	10:13-10:34	0.028	0.030	-0.002	Y	217.0
7	6/9/2022	10:45-11:06	0.028	0.030	-0.002	Y	207.2
8	6/9/2022	11:15-11:36	0.027	0.030	-0.003	N	206.9
9	6/9/2022	11:45-12:06	0.028	0.030	-0.002	Y	206.3
10	6/9/2022	12:24-12:45	0.028	0.030	-0.002	Y	215.1
Averages			0.028	0.030	-0.002		208.2
Standard Deviation			0.0002				
Confidence Coefficient (CC)			0.0001				
Unit Load			Normal	>50% of maximum rated capacity			
RA based on mean RM value			8.03	%			

**Table 4-2
NO_x (ppmvw) RATA Results -
EUBOILER#11 CEMS**

Run #	Date	Time	RM	CEMS	Difference	Run Used (Y/N)	Heat Input (MMBtu/hr)
1	6/9/2022	7:30-7:51	17.76	18.60	-0.84	Y	202.4
2	6/9/2022	8:05-8:26	17.68	18.40	-0.72	Y	200.7
3	6/9/2022	8:37-8:58	17.65	18.50	-0.85	Y	207.6
4	6/9/2022	9:10-9:31	17.72	18.50	-0.78	Y	207.5
5	6/9/2022	9:42-10:03	17.69	18.50	-0.81	Y	210.0
6	6/9/2022	10:13-10:34	17.73	18.70	-0.97	N	217.0
7	6/9/2022	10:45-11:06	17.70	18.50	-0.80	Y	207.2
8	6/9/2022	11:15-11:36	17.63	18.60	-0.97	Y	206.9
9	6/9/2022	11:45-12:06	17.65	18.60	-0.95	Y	206.3
10	6/9/2022	12:24-12:45	18.87	18.90	-0.03	Y	215.1
Averages			17.82	18.57	-0.75		207.1
Standard Deviation			0.2799				
Confidence Coefficient (CC)			0.2152				
Unit Load			Normal	>50% of maximum rated capacity			
RA based on mean RM value			5.42	%			

**Table 4-3
CO₂ (%-Wet) RATA Results -
EUBOILER#11 CEMS**

Run #	Date	Time	RM	CEMS	Difference	Run Used (Y/N)	Heat Input (MMBtu/hr)
1	6/9/2022	7:30-7:51	7.94	7.70	0.24	Y	202.4
2	6/9/2022	8:05-8:26	7.94	7.70	0.24	Y	200.7
3	6/9/2022	8:37-8:58	7.90	7.70	0.20	Y	207.6
4	6/9/2022	9:10-9:31	7.83	7.70	0.13	Y	207.5
5	6/9/2022	9:42-10:03	7.87	7.70	0.17	Y	210.0
6	6/9/2022	10:13-10:34	7.85	7.70	0.15	Y	217.0
7	6/9/2022	10:45-11:06	7.91	7.70	0.21	Y	207.2
8	6/9/2022	11:15-11:36	7.96	7.70	0.26	Y	206.9
9	6/9/2022	11:45-12:06	7.88	7.70	0.18	Y	206.3
10	6/9/2022	12:24-12:45	8.35	7.70	0.65	N	215.1
Averages			7.90	7.70	0.20		207.3
Unit Load			Normal	>50% of maximum rated capacity			
RA based on absolute difference			0.20	% as CO ₂			

5.0 Internal QA/QC Activities

5.1 QA/QC Audits

Table 5-1 presents a summary of the gas cylinder information.

Table 5-1
Part 60 Gas Cylinder Information

Gas Type	Gas Concentrations	Cylinder ID	Expiration Date
CO ₂ , Balance N ₂	10.09	CC469780	3/14/2030
CO ₂ , Balance N ₂	20.59	CC21126	5/17/2029
NO _x , Balance N ₂	49.94	ALM-066662	11/19/2023
NO _x , Balance N ₂	90.83	CC194558	6/3/2029

EPA Method 3A and 7E calibration audits were all within the measurement system performance specifications for the calibration drift checks, system calibration bias checks, and calibration error checks.

The NO₂ to NO converter efficiency check of the analyzer was conducted per the procedures in EPA Method 7E, Section 16.2.2. The conversion efficiency met the criteria.

5.2 QA/QC Discussion

All QA/QC criteria were met during this test program.

5.3 Quality Statement

Montrose is qualified to conduct this test program and has established a quality management system that led to accreditation with ASTM Standard D7036-04 (Standard Practice for Competence of Air Emission Testing Bodies). Montrose participates in annual functional assessments for conformance with D7036-04 which are conducted by the American Association for Laboratory Accreditation (A2LA). All testing performed by Montrose is supervised on site by at least one Qualified Individual (QI) as defined in D7036-04 Section 8.3.2. Data quality objectives for estimating measurement uncertainty within the documented limits in the test methods are met by using approved test protocols for each project as defined in D7036-04 Sections 7.2.1 and 12.10. Additional quality assurance information is included in the report appendices. The content of this report is modeled after the EPA Emission Measurement Center Guideline Document (GD-043).

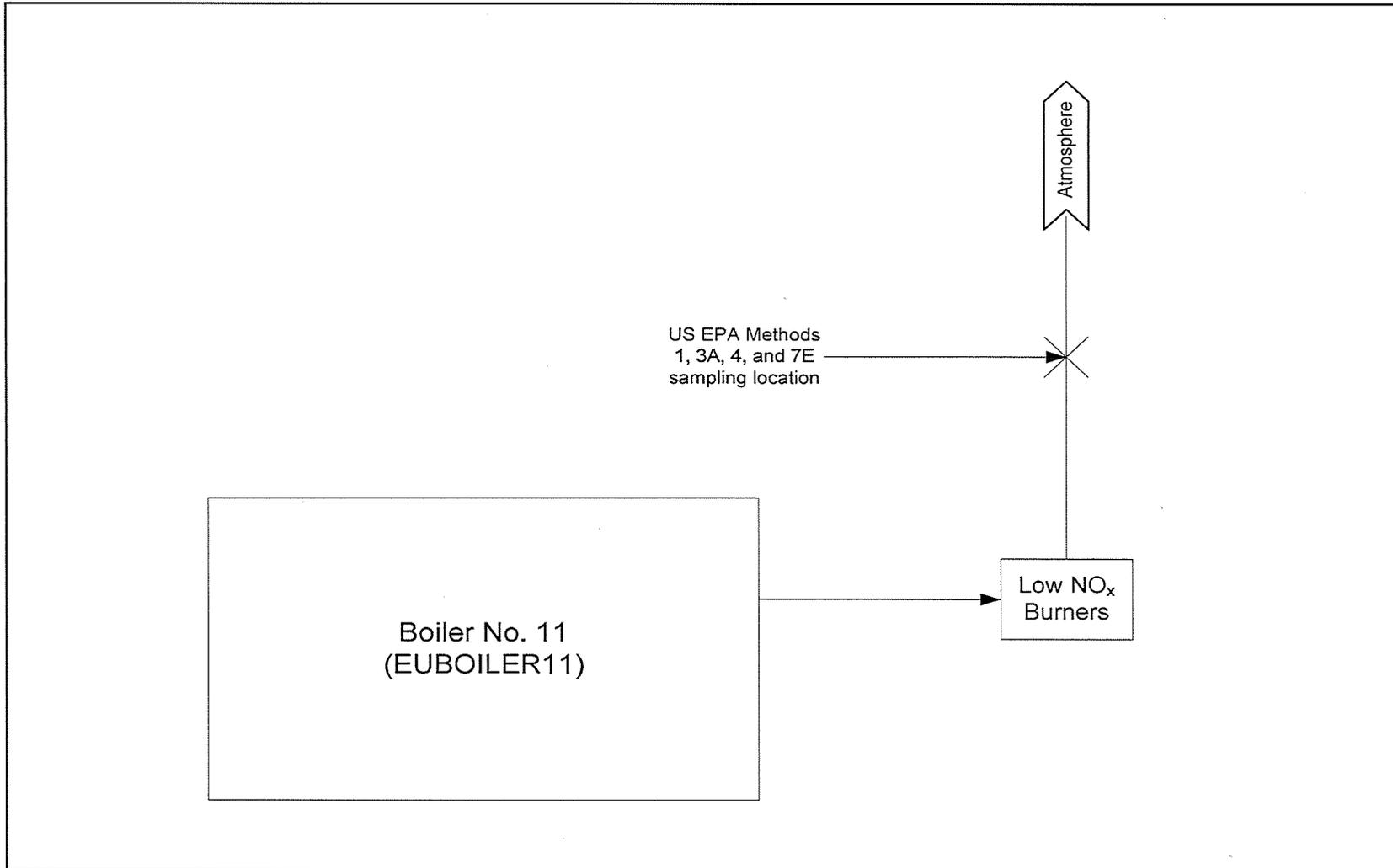
Appendix A

Field Data and Calculations

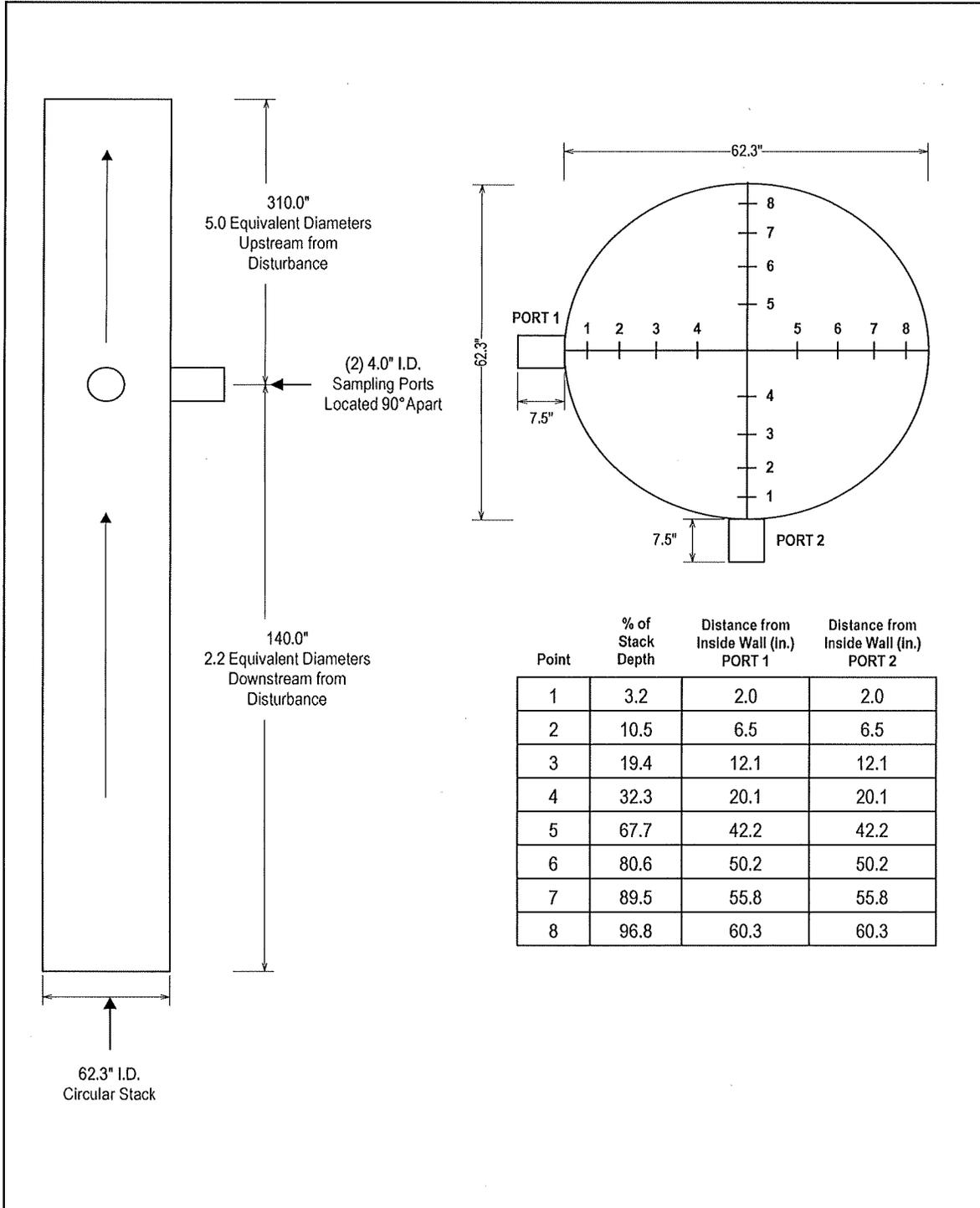
Appendix A.1

Sampling Locations

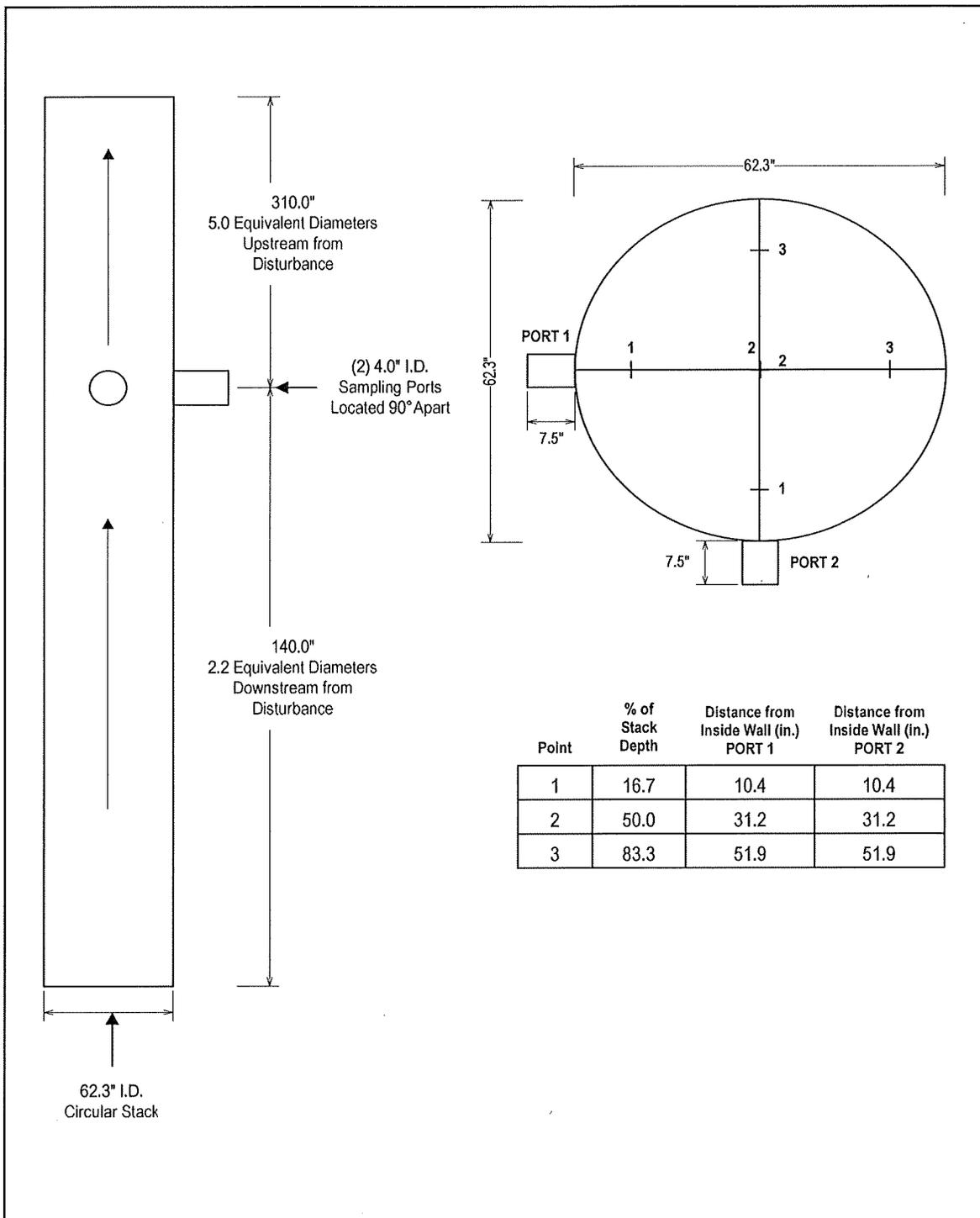
EUBOILER#11 SAMPLING LOCATION SCHEMATIC



EUBOILER#11 EXHAUST STACK FLOW TRAVERSE POINT LOCATION DRAWING



EUBOILER#11 EXHAUST STACK CEMS TRAVERSE POINT LOCATION DRAWING



This Page Left Intentionally Blank